10-25-2012

Developing an Introductory Statistics Course for Pre-service Elementary Teachers

Jennifer Green

University of Nebraska-Lincoln, jgreen@montana.edu

Abstract for DBER Group Discussion on 2012-10-25

Presenter, Department(s):
Jennifer Green
Research Assistant Professor
Department of Statistics; Center for Math, Science, and Computer Education

Title:
Developing an Introductory Statistics Course for Pre-service Elementary Teachers

Abstract:
Introductory statistics instruction is evolving to help create a statistically literate society. However, sound statistical reasoning skills are not obtained in one general education statistics course, but instead need to be nurtured and developed over the course of one's entire K-16 educational experience (Franklin & Kader, 2010). It is therefore imperative that elementary teachers be adequately prepared to foster statistical thinking in their students. While introductory statistics courses typically serve the need to create statistically literate citizens, they do not necessarily provide the opportunity to develop pedagogical content knowledge that goes beyond a basic understanding of the content teachers will be teaching.

Erin Blankenship and I recently developed an introductory statistics course for pre-service elementary teachers. The curriculum, focusing on modeling and simulation, coupled with additional activities, helps pre-service teachers gain a deeper understanding of statistical concepts as well as transfer those ideas to their future elementary classrooms. This talk will describe the course and provide example course work that captures the progression from student to novice teacher. Overall, the course helps pre-service teachers recognize the integral role they play in a student's entire education, and we hope it can serve as a model/resource for others interested in pre-service teacher development.

Primarily Statistics:

Developing an Introductory Statistics Course for Pre-service Elementary Teachers

Jennifer L. Green and Erin E. Blankenship
Department of Statistics

October 25, 2012

University of Nebraska Lincoln

The Landscape: Nationally

- Race to the Top (2009): Raise achievement and close gaps
  - Develop common standards and high-quality assessments
  - Build data systems:
    - Measure student growth
    - Inform improvements in instruction
  - Develop & support effective teachers and leaders
  - Turn around lowest-achieving schools

The Landscape: Nationally

- Common Core State Standards for Mathematics (CCSSM, 2010)
  - Higher expectations of students' understanding in math and statistics
  - Statistical preparation of K-12 teachers

The Landscape: Nationally

- MET Report (CBMS, 2001)

  "…[*High school* math ed majors] often find themselves thrust into a calculus-based mathematical statistics course, and are likely to miss many fundamental ideas and techniques that are at the heart of high school statistics and probability" (p. 44).

  "…[*Middle school* teachers] are least prepared to teach statistics and probability. Many…need convincing that they need to learn this mathematics to be prepared to teach in the middle grades" (p. 114).

  "…[M]ost *elementary* teachers have little or no experience in this vitally important field" (p. 87)

Developing Teachers of Statistics

- High student and teacher expectations demand high quality levels of support
- Develop habits of a mathematical (statistical) thinker:

"Teachers themselves need to learn to be critical consumers of data and statistical claims.… [and] should have experience *formulating questions*, *devising data collection protocols*, and *analyzing real data sets* that result from their own investigations or from the data collection of others." (MET Report, 2001, p. 115 & 136)

Developing Teachers of Statistics

- Post-GAISE introductory course
  - Creates statistically literate citizens
- Content knowledge vs. knowledge for teaching
- Introductory courses for teachers
  - Integrate content, pedagogy and assessment issues

Developing Teachers of Statistics

- In-service teacher courses:
  - Stats for Middle-Level Teachers (Summer 2006-2011)
  - Stats for High School Teachers (Summer 2010, 2012)
- Pre-service teacher course:
  - Stats for Elementary Teachers (Fall 2011)

Overview

- Course Description
  - Goals, Logistics, Topics
- Informal Assessments
  - In-class activities, Class discussion, Journals
- Formal Assessments
  - Exams, Lesson plans
- Reflections & Challenges

Pre-service Teacher Course: Goals

- Integrate *content and pedagogy* using inquiry-based, student-centered approaches and activities
- Develop *statistical habits of mind*; focus on interpretations and meaning
- Develop an *appreciation of statistics* as a discipline separate from mathematics; make connections to multiple subjects
- Incorporate *statistics standards* (NE, NCTM, CCSSM)
- Transition from *student* to *novice teacher*

Pre-service Teacher Course: Logistics

- Special section of general intro course
  - Fall 2011: 26 students; 65% first-semester freshmen
- Co-taught by 2 faculty members
- Inquiry-based, student-centered instruction
  - Collaborated with University of Minnesota (CATALST, NSF DUE 0814433) to adapt activities for use with pre-service teachers
  - No lectures; group work, activities and discussion
  - Emphasis on applications and statistical thinking

Pre-service Teacher Course: Topics

- Chance Models and Simulation (CATALST)
  - Investigate differences between theoretical and empirical prob.
  - Inference via simulated p-values
- Data Summary
  - Translate knowledge about graphical and numerical summaries into classroom practice
- Models for Comparing Groups (CATALST)
  - Inference via simulated p-values (randomization tests)
  - Connections to elementary classroom

Informal Assessment: In-class Activities

- Real Scenario
  - Helper or Hinderer?
- Research Question
  - Are infants able to notice & react to helpful or hindering behavior observed in others?
- Simulation Study
  - Tinkerplots™
  - Is the observed result (14 out of 16 choosing helper) surprising if infants have no real preference?

Informal Assessment: In-class Activities

- How do you think this activity compares to the intro of p-values in more traditional intro courses?
- What aspects of this activity do you think would be successful in developing students' understanding? What aspects would students struggle with?

Informal Assessment: Class Discussion

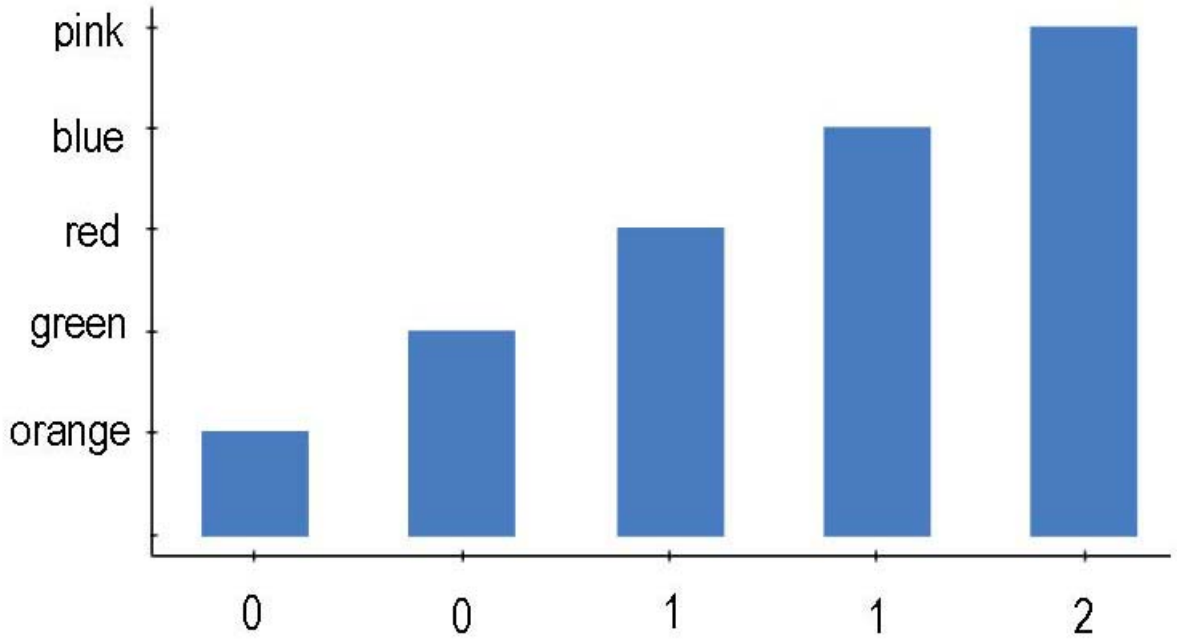
- Journal Articles
  - *NCTM Yearbook: Thinking and Reasoning with Data and Chance*
    - *Graphing with Four-Year-Olds* (Schwartz & Whitin, 2006)
    - *More than "Meanmedianmode" and a Bar Graph: What's Needed to Have a Statistical Conversation* (Friel et al., 2006)
  - How did today's discussions support, challenge and/or affect any of your previously held views about teaching? Discuss how this impacted your teaching philosophy.

Informal Assessment: Journals

- Journal Reflections
  - *What is your definition of random and why? How would you define random to a 2nd grader? A 6th grader?*
  - *How has your opinion about the relationship between mathematics and statistics changed over the course of the semester? How can you communicate their differences in the classroom?*

Formal Assessment: Exams

- Assess content and content knowledge for teaching
  - Example: *What is your favorite color?*



Formal Assessment: Lesson Plans

- Translate knowledge into classroom practice
  - Probability
  - Data summary
  - Common misconception in stats
- Address standards, assess student understanding, grade-level appropriate
- Peer- and instructor-reviewed with chance for revision before grading

Reflections & Challenges

- 65% first-semester freshman
  - Little/no experience with classrooms
  - Student → Novice teacher
- Teacher-dependent learners → Independent problem solvers
- Creating authentic exams
- Big picture
  - Data are numbers with *context*
  - "Fuzziness" vs. "rules"
  - Implications for their future classrooms

Conclusions

- High student and teacher expectations demand high quality levels of support
- Key ingredients for developing teachers of statistics:
  - Integration of *content, pedagogy and assessment* issues
  - Support and appreciation for the roles *statisticians* should assume in course development and research
  - *Collaborations* between statisticians, mathematicians, math & teacher educators, and local school districts

This work is partially supported by the NSF,

(EHR 0412502 Math in the Middle Institute Partnership, DUE 0831835 NebraskaMATH, DUE 1050667 Data Connections and DUE 0814433 CATALST)

jennifer.green@unl.edu erin.blankenship@unl.edu

University of Nebraska Lincoln